NAMAL UNIVERSITY MIANWALI
DEPARTMENT OF ELECTRICAL ENGINEERING

Communication Systems (Lab)
LAB # 07
REPORT

Title :
Frequency Modulation and Demodulation

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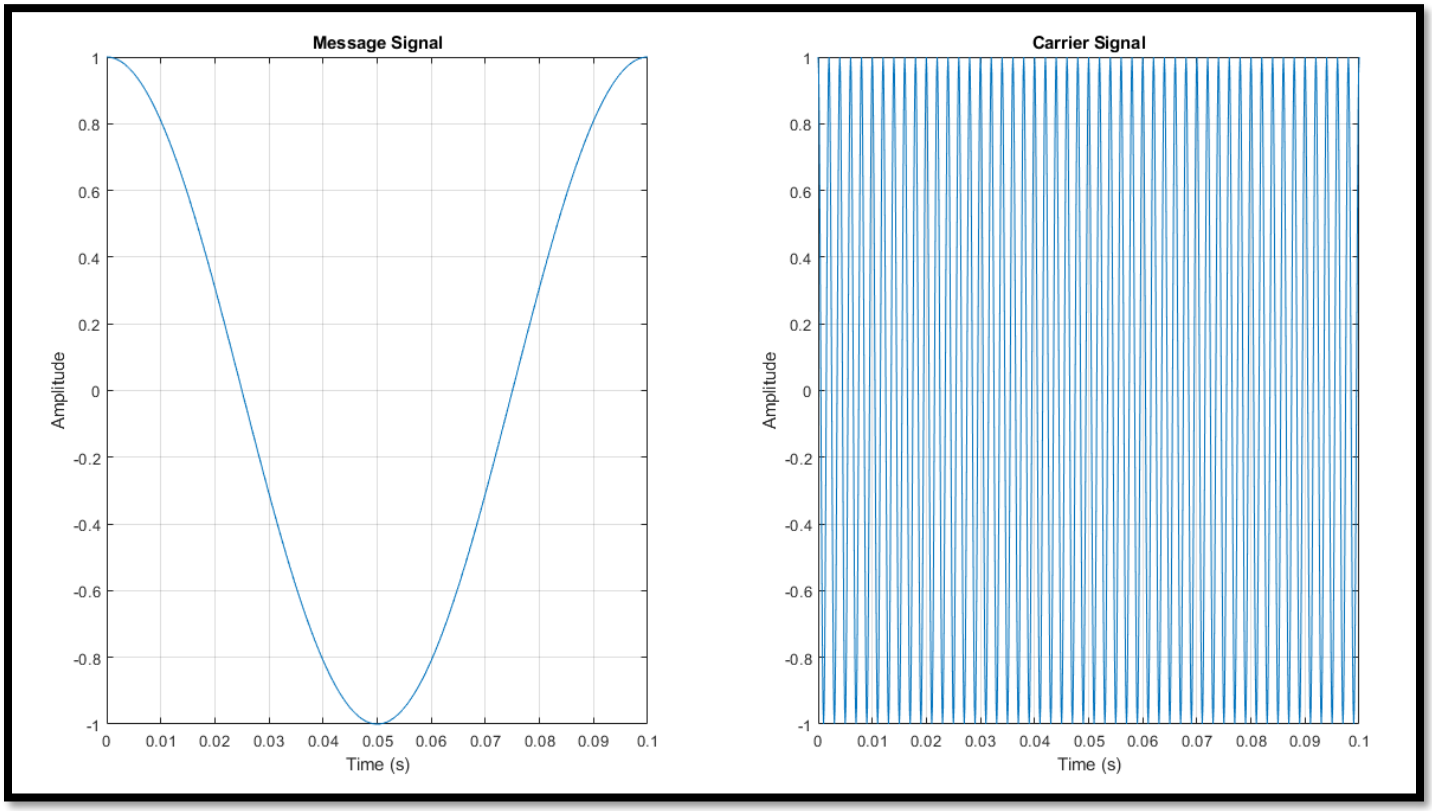
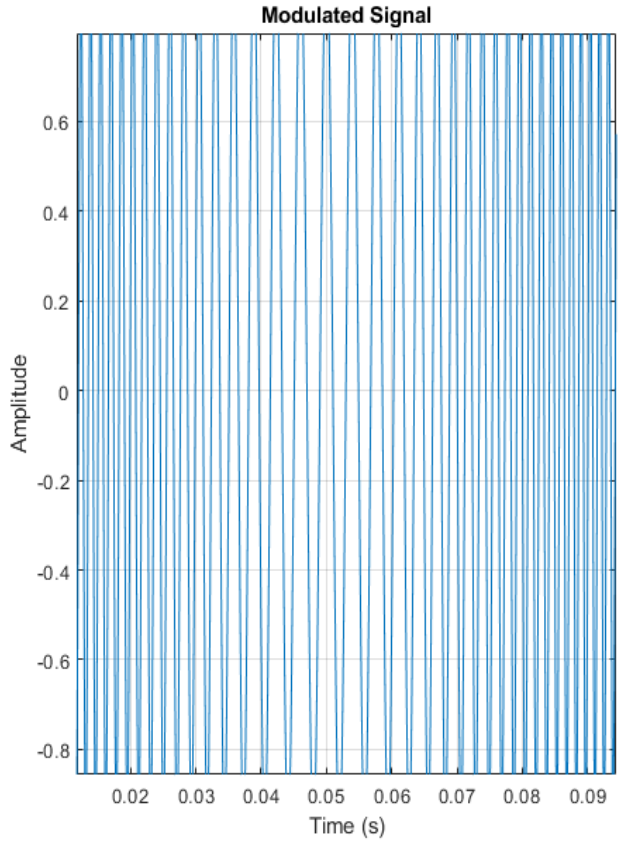
Lab Engineer	*Engr. Faizan Ahmad*
Date Performed	*22-April-2024*
Marks	

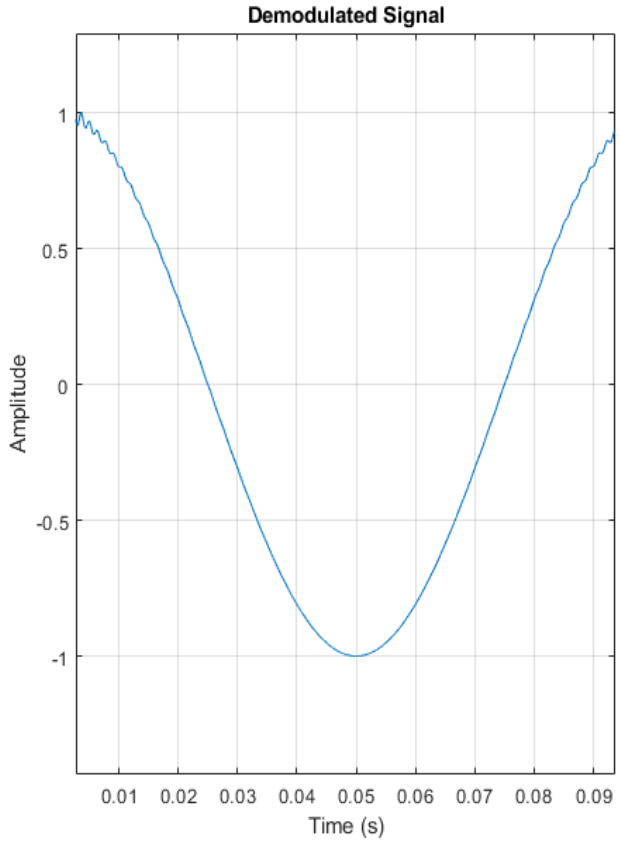
```
% Parameters
fm = 10;          % Message signal frequency (Hz)
Am = 1;           % Message signal amplitude
theta_m = 0;      % Message signal phase
fs = 10000;       % Sampling frequency
fc = 500;         % Carrier frequency (Hz)
Ac = 1;           % Carrier amplitude
theta_c = 0;      % Carrier phase
freq_dev = 250;  % Frequency deviation factor
% Time scale
t = 0:1/fs:0.1;  % Time scale for one time period of the message signal
% Message signal
message_signal = Am * cos(2*pi*fm*t + theta_m);
% Modulation
modulated_signal = fmmod(message_signal, fc, fs, freq_dev);
% Demodulation
demodulated_signal = fmdemod(modulated_signal, fc, fs, freq_dev);

% Magnitude spectrum of input signal
input_spectrum = abs(fft(message_signal));

% Magnitude spectrum of demodulated signal
demodulated_spectrum = abs(fft(demodulated_signal));

% Carrier signal
carrier_signal = Ac * cos(2*pi*fc*t + theta_c);

% Plotting
figure;
subplot(1,2,1);
plot(t, message_signal);
title('Message Signal');
xlabel('Time (s)');
ylabel('Amplitude');
grid on;

subplot(1,2,2);
plot(t, carrier_signal);
title('Carrier Signal');
xlabel('Time (s)');
ylabel('Amplitude');
grid on;
figure

subplot(1,2,1);
plot(t, modulated_signal);
title('Modulated Signal');
xlabel('Time (s)');
ylabel('Amplitude');
grid on;
```

```
subplot(1,2,2);
plot(t, demodulated_signal);
title('Demodulated Signal');
xlabel('Time (s)');
ylabel('Amplitude');
grid on;
figure;

subplot(1,2,1);
plot(abs(input_spectrum));
title('Magnitude Spectrum of Input Signal');
xlabel('Frequency (Hz)');
ylabel('Magnitude');
grid on;

subplot(1,2,2);
plot(abs(demodulated_spectrum));
title('Magnitude Spectrum of Demodulated Signal');
xlabel('Frequency (Hz)');
ylabel('Magnitude');
grid on;

% Adjusting layout
sgtitle('Frequency Modulation and Demodulation');
```

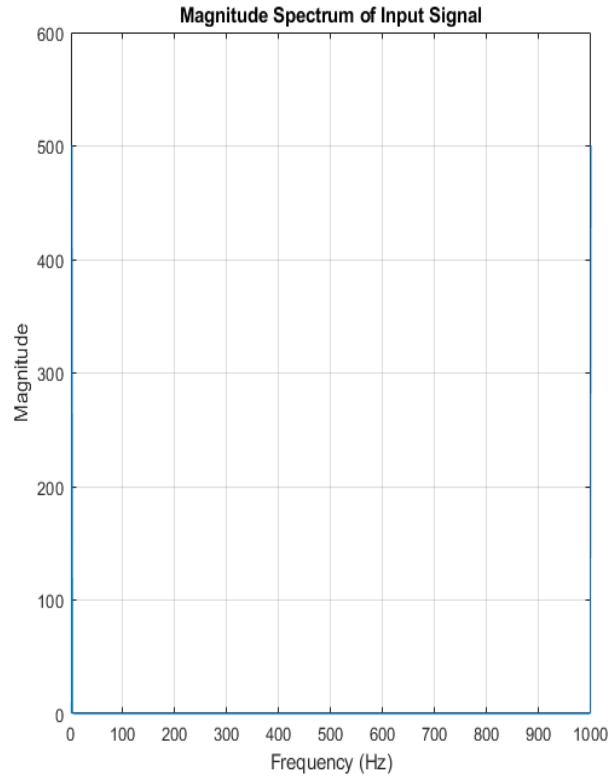
Output:

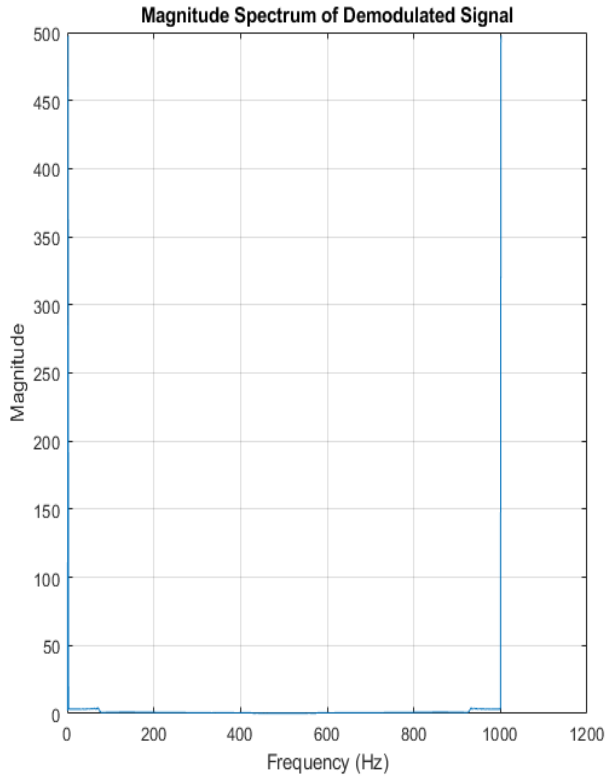




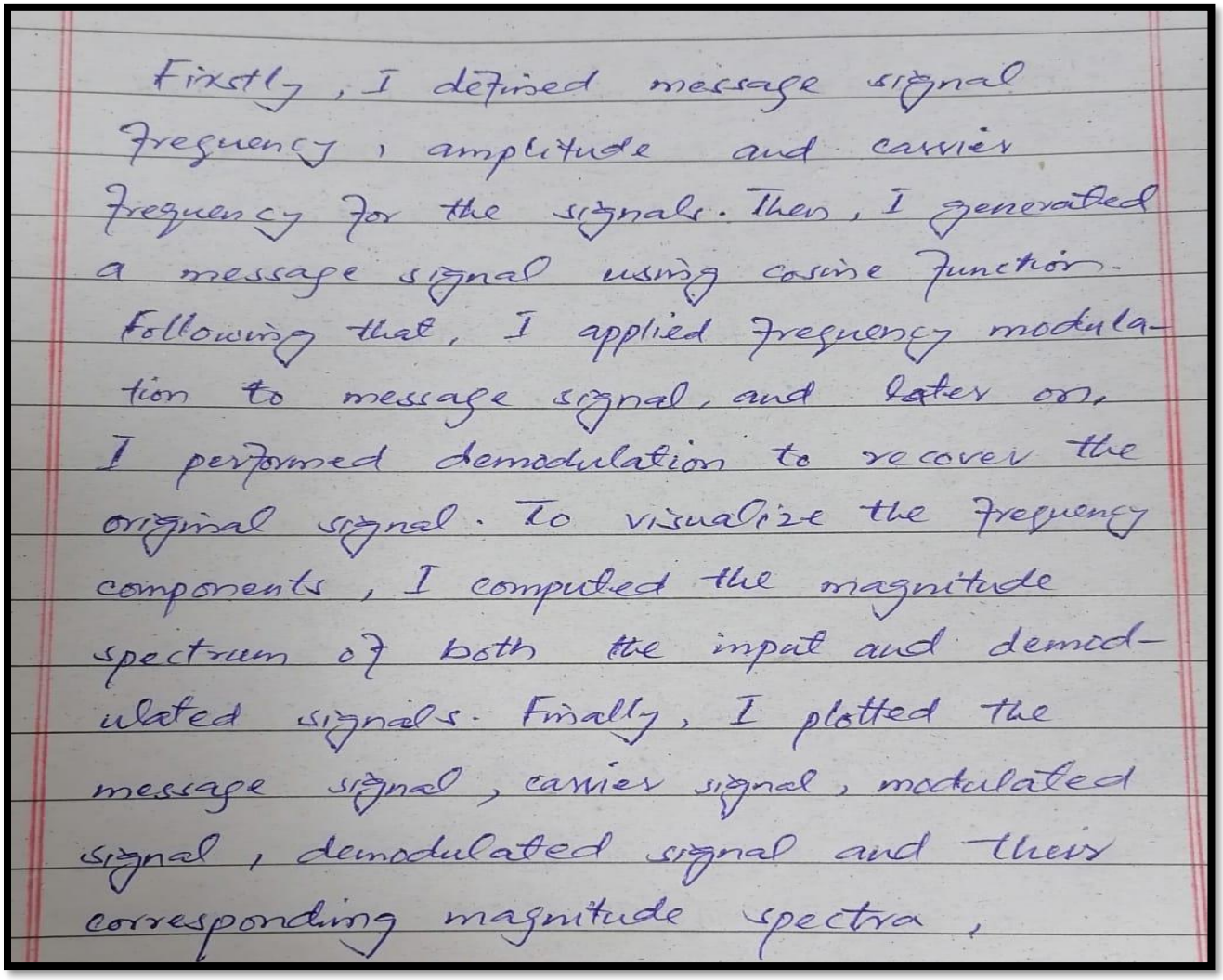


Frequency Modulation and Demodulation





Explanation:

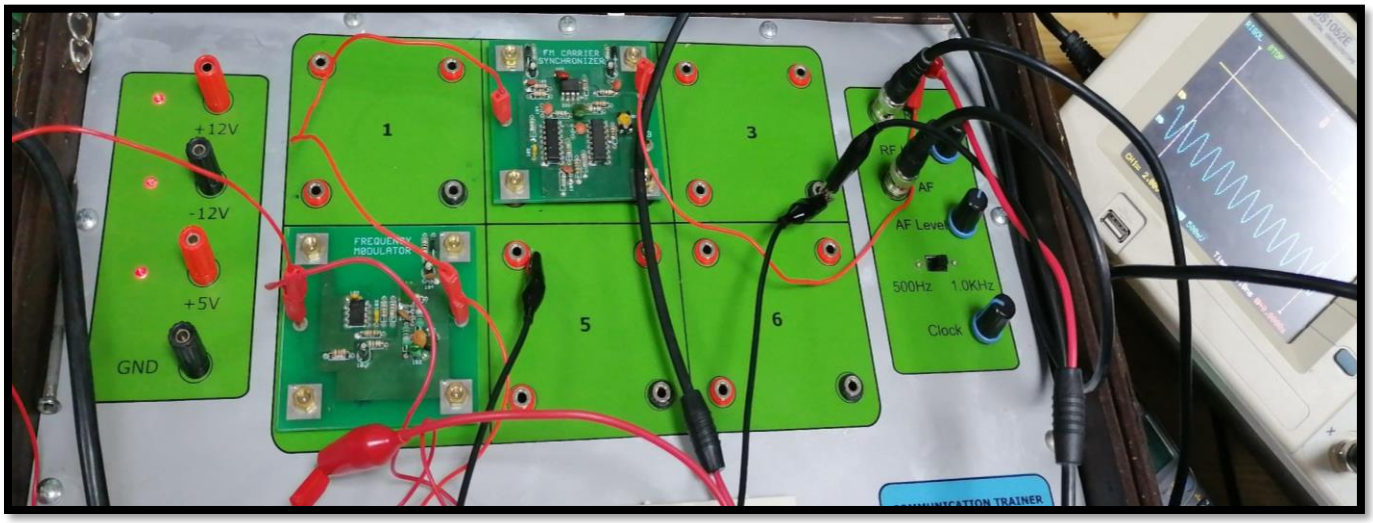

Firstly, I defined message signal frequency, amplitude and carrier frequency for the signals. Then, I generated a message signal using cosine function. Following that, I applied frequency modulation to message signal, and later on, I performed demodulation to recover the original signal. To visualize the frequency components, I computed the magnitude spectrum of both the input and demodulated signals. Finally, I plotted the message signal, carrier signal, modulated signal, demodulated signal and their corresponding magnitude spectra,

Task 2 – Hardware Procedure

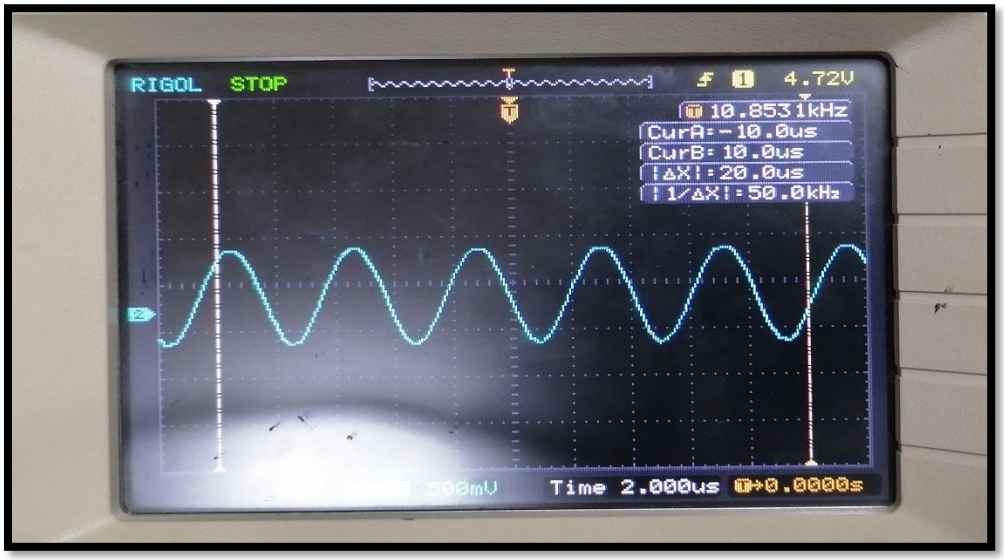
- First of all energize CT-3000 communication Trainer by applying 220VAC.
- For frequency modulation and demodulation, FM module is inserted in socket 4 and FM Carrier synchronizer module is inserted in socket 2.
- Set the message signal AF of 1 KHz and carrier signal RF of 10MHz directly from trainer at J1 port of FM module.
- Then, frequency modulated signal is observed, at J2 of FM module, on oscilloscope by using prob.
- Now, J2 of FM module is connected to J1 of FMCS module by using connecting wire and demodulated signal is observed at J2 on oscilloscope by using prob. Show the output to an instructor.

Observations:

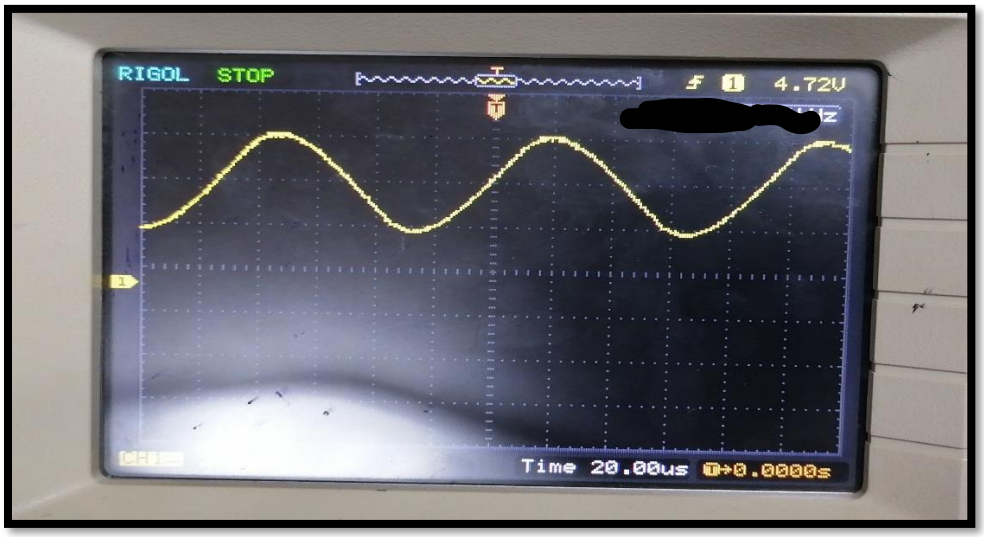
Circuit:



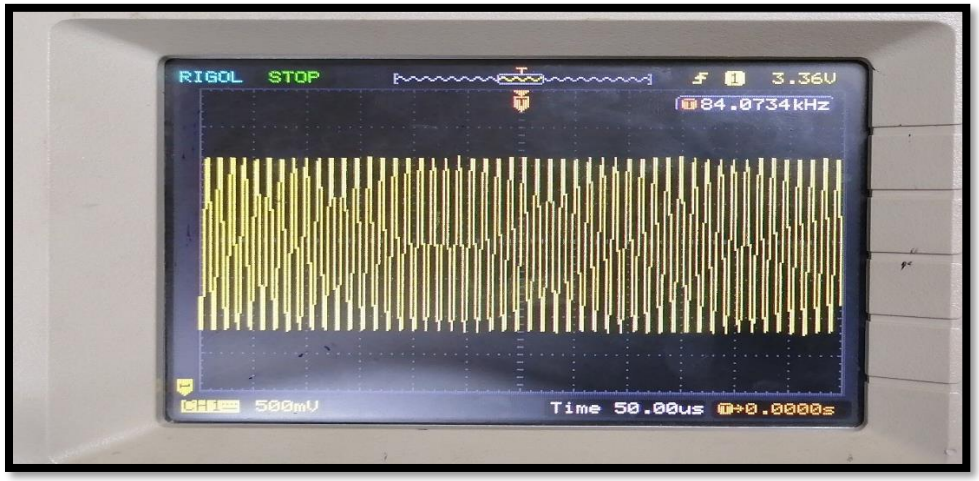
Input Waveform:



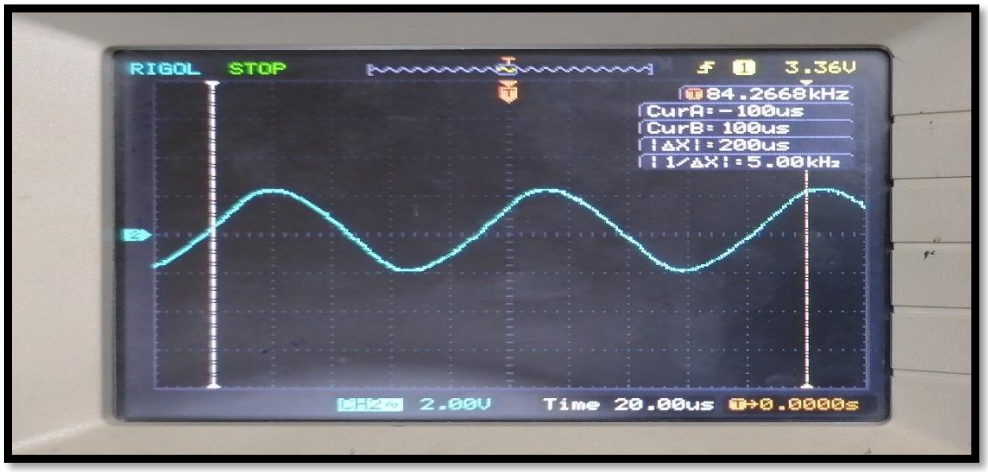
Carrier Waveform:



Modulated Waveform:



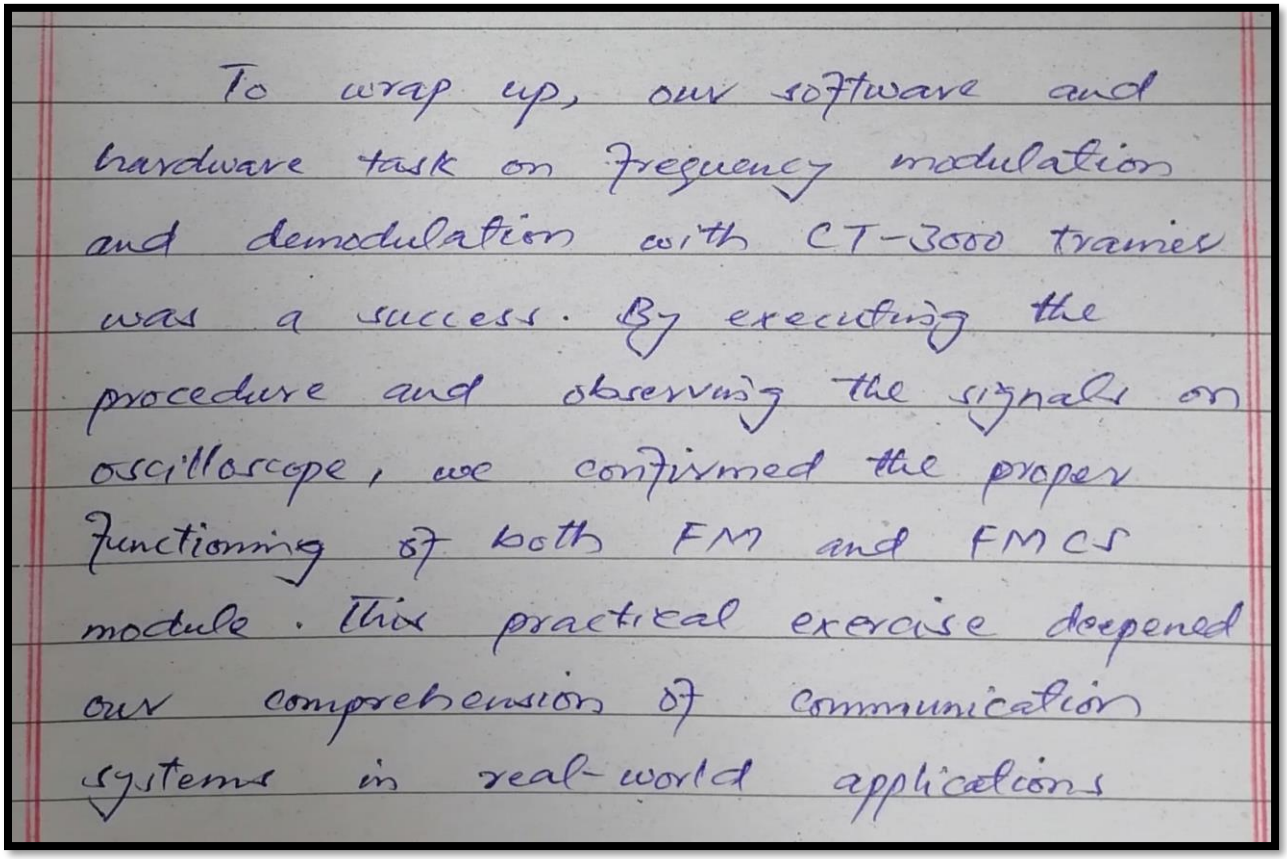
Demodulated Waveform:



Explanation:

In this task, we powered up CT-3000 trainer and inserted FM module into socket 4 & FM carrier synchronizer into socket 2. Setting message signal to 1KHz and carrier to 10 MHz. We observed the modulated signal on oscilloscope at J2 of FM module. Then we connected J2 of FM module to J1 of FMCS and observed demodulated signal at J2 on oscilloscope.

Conclusion:



To wrap up, our software and hardware task on frequency modulation and demodulation with CT-3000 trainer was a success. By executing the procedure and observing the signals on oscilloscope, we confirmed the proper functioning of both FM and FMCS module. This practical exercise deepened our comprehension of communication systems in real-world applications